Operational Response to the COVID-19 Pandemic at Allegheny General Hospital (Pittsburgh, PA)

by

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ABSTRACT

Healthcare institutions are complex organizations that require capable and agile leadership to navigate the intricacies that are faced on a daily basis. The COVID-19 pandemic has forced hospital leadership to respond with the same agility and expertise that places an emphasis on the safety and well-being of the patient and staff. At Allegheny General Hospital (AGH) in Pittsburgh, Pennsylvania, nursing leadership was responsible for the operational response to the pandemic and worked closely with departments throughout the hospital to ensure the safety of all that entered the hospital.

Considerations surrounding space planning, staffing, personal protective equipment, and cross-functional department involvement helped to create a comprehensive plan to quickly prepare for the virus to infiltrate the hospital. Led by the Chief Nursing Officer and Directors of Nursing, the response required a diligent meeting cadence, collaboration across departments, and a sense of urgency to allow AGH to be prepared for any imminent danger posed by the virus. The planning and initial response spanned the timeline of about a month and a half from late March to mid-May.

Hospital operations and surge planning efforts held significant public health relevance in the country's response to COVID-19. Although it's difficult to determine success throughout a deadly pandemic that has claimed many innocent lives, AGH's pandemic response is largely deemed a pandemic surge planning and bed capacity success story. Though many obstacles were

presented, the nursing administration and other stakeholders addressed concerns adequately, and made facility and staffing provisions that has allowed staff the ability to perform their life-saving work successfully throughout the course of the COVID-19 pandemic.

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1.0 INTRODUCTION

The COVID-19 pandemic offered unprecedented challenges to healthcare organizations that taxed hospital leadership's emergency management and agility to respond to unpredictable events. Early in the pandemic, originally declared in March 2020, facilities were faced with the task of preparing for a viral infection that was not thoroughly researched and was novel in nature. While addressing acute conditions already presented, Allegheny General Hospital (AGH) staff was forced to adapt to treating critically ill COVID-19 patients, enacting necessary facility changes to effectively treat these patients, preparing for a potential influx of infected patients, all while continually learning the nuances of the disease. Facilitating this response was a massive undertaking, yet shed light on potential areas for improvement and was an exercise on crisis management.

1.1 SARS-CoV-2 (COVID-19)

SARS-CoV-2, otherwise known as severe acute respiratory syndrome – coronavirus 2 (COVID-19), is primarily an upper-respiratory disease that leads to mild to moderate respiratory illness. However, elderly people, those with preexisting conditions and comorbidities, are more susceptible to severe illness, which can lead to death. The disease is transmitted through saliva droplets from the nose or mouth and is more contagious than influenza (Coronavirus, 2021). The virus was first identified in the Wuhan, Hubei province in China on January 4, 2020 after a cluster of 'viral pneumonia' cases were reported. On January 9, 2020 it was determined that the virus that

caused the pneumonia was classified as a “novel coronavirus”, which alludes to the variable symptomatic nature of the illness. Within weeks of the rapid spread of COVID-19, the United States reported its first case of COVID-19 on January 21, 2020, while AGH saw its first hospitalization in late March. Since the first identified case of COVID-19 in the United States, the country has experienced nearly 30 million cases and roughly 500,000 deaths due to the virus (Listings of WHO's Response to COVID-19, 2021)

1.2 ALLEGHENY GENERAL HOSPITAL

AGH is a Level-1 Trauma Center located on the North Side of Pittsburgh, Pennsylvania. Known as the academic flagship of the health system, Allegheny Health Network (AHN), the hospital employs over 1,000 physicians and roughly 5,000 additional staff members. Founded in 1885, the hospital has evolved from a 50-bed community hospital to a 576 licensed bed hospital that serves patients nationally. Within the main hospital lies Snyder Pavilion, which houses 12 inpatient floors (17 total units) and is where most patients are tended to upon admission. The institution has developed into a national leader in cancer, cardiovascular, neuroscience, transplant surgery, and orthopaedic care. AGH works in unison with its network sister hospitals, neighborhood hospitals, and outpatient clinics to deliver quality care to all patients. AGH and AHN are a part of the larger Integrated Delivery and Financing System, Highmark Health, which serves patients and insurance enrollees nationwide (Allegheny General Hospital: Fast Facts, n.d).

1.3 AUTHOR'S ROLE

The author was given the role of operational representation on the hospital's COVID-19 Response Team. Primarily handling project management responsibilities, the author attended daily morning meetings to assess progress on facility changes, received updates on virus transmissions, and engaged with nearly 30 departmental representatives to work through their hospital-specific needs while updating the project planner for the planning committee. Additionally, the author worked directly with the Chief Nursing Officer (CNO) and two Directors of Nursing (DON) to create surge planning documents and to discuss facility changes that needed to be enacted to care for airborne, isolated COVID-19 patients, and coordinated documents to responsible parties. The author worked directly with nursing, regulatory, respiratory therapy, facilities, environmental services, information technology, pharmacy and the dietary teams to assure the hospital was prepared for every potential COVID-19-related outcome.

2.0 LITERATURE REVIEW

"Surge capacity generally refers to the ability of a health system to maintain a sudden, unexpected increase in patient volume that would otherwise severely challenge or exceed the present capacity of the system" (Squitieri et al., 2020). It's important for health care systems to take into account worst case and best case scenarios when planning for a surge of patients and preparing to meet the capacity needed to tend to them. Space, staff, and supplies are used tactfully to address the needs of the expected increased patient population. Often, planning capacity within a surge plan involves the utilization of adaptive space in an attempt to add beds for patients, even if these beds aren't necessarily in a traditional setting. In a JAMA study spanning 2017-2018, researchers found that key capacity managers at 53 hospitals revealed that their hospitals were unprepared to meet surge capacity. The study found that during the 2017-2018 flu epidemic, hospitals lacked surge capacity (beds), staffing, and supplies to meet the need of imminent increased capacity (Harris et al., 2021). It revealed that surge and pandemic planning was not a high priority for hospitals, which was further exploited by the COVID-19 pandemic.

Many studies at the outset of the COVID-19 pandemic indicated that bed capacity, specifically critical care bed capacity wouldn't be adequate. According to one study, it was noted that there are 792,417 hospital beds available in the United States, 97,776 of which are within ICUs. While on the surface, this number seems sufficient to withstand even the most extreme pandemic surge, it's important to note that about 65% of these beds were being used in the absence of a public health emergency. To project the timing of the outbreak peak and the number of ICU beds required at peak, the study simulated a COVID-19 outbreak parametrized with the United States population demographics. The results of the study showed that an outbreak similar to that

seen in China and other areas around the world would significantly challenge the capacity of critical care beds in the United States (Moghadas et al., 2020). Studies similar to this stressed the importance of bed planning and the necessity to adding bed capacity to accommodate the increasing hospitalization of critically ill COVID-19 patients.

While the country understood the need to plan bed capacity for the virus, it became apparent that planning was much more unpredictable than originally expected. According to a checklist for pandemic planning developed by the Assistant Secretary for Preparedness and Response (ASPR), it's of the utmost importance to initially identify 20% of total bed capacity as immediately available in order to mitigate the need to perform any more initial adaptive bed planning (Interim Healthcare Coalition Checklist for Pandemic Planning, 2013). In identifying initial bed availability, hospitals, nursing homes, community health centers, etc. allow themselves the agility to use available beds as a buffer between best and worst case scenarios in their surge capacity response. Michigan Medicine designated both critical and non-critical care beds in their initial pandemic bed planning. They also established a schedule for hospitalists and critical care providers to oversee COVID-19 patients (Chopra et al., 2020). While these plans provide a baseline for what's expected in surge planning, it's extremely difficult to pinpoint exactly how many beds will be needed to accommodate these critically ill patients and the staff that'll be required, as well. Predictive modeling has been proposed to assist hospitals with preparing for bed planning and surge capacity limits using data regarding viral transmission rates and patient demographic information. This type of modeling allows for hospitals to prepare a rough estimate in terms of ICU capacity and overall bed capacity to meet the need of the increased patient population. With COVID-19 and the novel nature of the virus, it was difficult to accurately predict the appropriate number of beds even with predictive modeling. The virus didn't behave like typical

viruses and was much more infectious, which made it difficult to make reliable predictions for hospitals to accurately plan surge capacity (Aziz et al., 2020).

While the COVID-19 virus is difficult to predict, and in addition to identifying an additional 20% of immediately available beds, hospitals can easily identify space that can be utilized as an isolation ICU. These ICUs are geographically separated from other clinical areas to allow for concentration of staff and resources while reducing the risk of cross-contamination of other patients in neighboring units. Ideally, the isolation ICUs should contain negative air pressure rooms, which force air to be maintained within a particular space. If a completely isolated ICU space outfitted with negative air pressure rooms isn't available, hospitals can geographically cohort patients in an open space with 2 meters of space between each patient (Goh et al., 2020). In addition to planning ICU surge capacity, it's important to realize the duties of hospitals and other health systems to care for patients without COVID-19. Managing the influx of highly infectious patients and typical patient caseload is difficult to balance, but imperative maintaining the health and well-being of all patients.

In a particular instance at a hospital in New York City, similar surge capacity plans were made, followed, and executed appropriately, yet their ICU capacity wasn't extensive enough to meet the needs of the influx of COVID-19 patients. At this particular hospital, the first critically ill COVID-19 patients were admitted to negative pressure rooms throughout multiple ICUs within the hospital. Their plans were to contain their infected COVID-19 patients in negative air pressure rooms spread throughout the hospital, but incorporated later stage plans that afforded the hospital 3 times the amount of bed capacity. As COVID-19 patient volume increased, the hospital designated half of the beds in multiple ICUs as COVID-19 units. This afforded their staff the opportunity to get familiar with the processes and cautionary measures needed to be taken to

accommodate COVID-19 patients, while developing an expertise in caring for these unique patients. However, within 3 weeks of admitting their first COVID-19 patients, the hospital completely filled multiple ICUs. At this point, it was important for the hospital to strategically manage bed capacity by downgrading less acute cases of COVID-19 to medical surgical units across the hospital. As units filled, additional bed capacity was identified and non-traditional ICUs were created in an attempt to meet the growing demand for ICU beds (Griffin et al., 2020). This particular example of bed capacity planning through the lens of the COVID-19 pandemic provides context around the unpredictability of the virus and the need to make contingency plans to accommodate the needs of critically ill patients. New York City was, also, one of the most heavily impacted cities by COVID-19 infection. Therefore, it's important to view this case as a "worst case" scenario, yet as a lesson to be learned for hospitals around the world in terms of preparation and surge planning.

While the COVID-19 pandemic continues to place tremendous burden on hospitals, it's important to reflect on the steps taken to appropriately prepare critical care and non-critical care beds for a pandemic. Striking an appropriate balance between treating critically ill COVID-19 patients while tending to the needs of the non-COVID-19 patients is an important consideration. While there's no definite right or wrong way to prepare for pandemic surge capacity, meticulously considering an array of scenarios will help to solidify plans for an effective pandemic, and specifically, capacity planning response (Goh et al., 2020).

3.0 PLANNING COMMITTEE

As first introduced by the author in a publication by DiCuccio et al., the following events outline the pandemic response at AGH (DiCuccio et al., 2020). AGH leadership determined that it was in the best interest of the institution to allow for nursing to lead the response to COVID-19. Nursing is an integral aspect to any hospital's operations, and since nurses would be a primary stakeholder in the way the hospital responded due to their clinical, patient-facing nature, it was logical to allow the CNO and Nursing Administration to take executive lead on this initiative. In order to keep the team intact and healthy, the CNO assigned two Directors of Nursing to lead the on-site response to the pandemic, while the other two Directors of Nursing were to work remotely and to take the lead on coordinating our response. At this time that the CNO engaged the author for assistance in the planning stages and overall execution of the hospital's response plan. The DONs coordinating the surge plan then began to engage integral stakeholders from departments around the hospital. This plan not only allowed for a "safety net" backup in the occurrence that the on-site nursing representation fell ill, it also allowed the CNO and the on-site DONs to focus on the facility progress and employee concerns amidst the pandemic.

4.0 WORKSTREAM METHODOLOGY

Rather than centralizing the project, it was determined that the most effective approach was to utilize stakeholders to lead their own workstreams given their expertise in their respective fields. The following workstreams were identified (**Appendix A**):

- Space Planning
    - Preparation of Medical Intensive Care Unit (MICU)
    - Preparation of Negative Pressure Postanesthesia Unit (PACU) ICU
    - Preparation of Clinical Decision Unit (CDU) to ICU
    - Combining and Moving Intensive Care Units (ICUs)
- Staffing Considerations
- Employee Wellness
- Personal Protective Equipment
- Ancillary Service Line Involvement
    - Information Technology (IT)
    - Pharmacy
    - Respiratory Therapy (RT)
    - Dietary Services
    - Environmental Services (EVS)

5.0 SPACE PLANNING

At the outset of the pandemic, it was imperative that AGH leadership identify units within the hospital that could be used to bed infected COVID-19 patients. Additionally, determining the number of negative pressure rooms that were available to accommodate infectious disease patients was incredibly important in assessing the options in-house. A combination of expertise in treating critically ill patients as well as facility accommodations were considered in this process. According to the CDC, "Positive and negative pressures refer to a pressure differential between two adjacent air spaces (e.g., rooms and hallways). Air flows away from areas or rooms with positive pressure (pressurized), while air flows into areas with negative pressure (depressurized)" (Air, 2019). Therefore, assuring that air is not flowing out of COVID-19 units was an important consideration. Leadership determined that the MICU, the PACU, which was typically used to house individuals recovering from surgeries to wake from anesthesia, and if needed, the CDU, which is the hospital's designated observation patient unit, were all viable options to house COVID-19 patients.

5.1 MEDICAL INTENSIVE CARE UNIT (MICU)

The ideal unit identified for treating critically ill COVID-19 patients was the MICU. The staff on the MICU was accustomed to treating a diverse range of highly acute patients. The MICU was easily divided into two separate units – MICU North (12 beds) and MICU South (16 beds). The bed count for the entire unit provided enough capacity for 28 patients, yet breaking the unit

into two separate subunits allowed for MICU South to be designated as an entirely negative pressure unit. Multiple negative air pressure machines were purchased, which allowed for MICU South to total 16 negative pressure beds in all. This also allowed for MICU North staff to continue to treat acute patients without COVID-19 and limited concerns of cross-contamination between units (**Appendix B**).

5.2 POSTANESTHESIA CARE UNIT (PACU)

Due to the cancellation of elective surgeries at AGH amid concerns of operating on patients with COVID-19 and little known about the virus, the operating schedule and, transitively, the postanesthesia care unit saw extremely low volume. This allowed AGH leadership to identify the PACU as a viable unit to house COVID-19 patients. According to a patient flow algorithm developed by hospital leadership (**Figure 1**), at the time that the MICU hit the capacity trigger point, the PACU became the next placement area for critically ill COVID-19 patients. However, this unit wasn't staffed to act as an ICU nor was it equipped with the supplies and equipment to support high acuity patients.

A core staff of volunteer registered nurses that were either displaced from their home units due to lack volume or willingly chose to volunteer their services for this unit were led by an already appointed high-performing nurse manager. This group worked collaboratively with other staff at the hospital to transition this space to a fully functioning ICU for surge planning efforts. Modifications and additions to the PACU included: environmental updates, equipment and supply allocation, and involvement of all ancillary services that support a standard inpatient unit. All of these main considerations for PACU preparation were important to align for a successful "PACU

ICU" opening in time for a potential surge. Upon completion, this space added an additional 38 negative pressure beds for potentially critically ill COVID-19 patients (**Appendix C**).

5.3 CLINICAL DECISION UNIT (CDU)

The CDU was on the plan and had the ability to be converted to entirely negative pressure. This unit, which is positioned adjacent to the Emergency Department and used to observe patients while assessing their need to be bedded at the hospital, would have added an additional 20 beds to the operational response plan for COVID-19 patients. The unit maintained the equipment to manage and monitor critically ill COVID-19 patients. An identical process would have been followed in the CDU that occurred in the PACU. However, though prepared to enact changes at a moment's notice, AGH never needed to prepare the CDU to take COVID-19 patients due to sufficient capacity in the MICU and PACU ICU for critically ill COVID-19 patients and capacity dispersed throughout medical telemetry units for less acute cases of COVID-19.

5.4 OTHER UNIT MOVEMENT

Due to all of the facility changes that were being enacted to prepare for a potential surge in COVID-19 patients, nursing administration paired with facilities management played a major role in preparing all other unit shifts throughout the hospital. Because the PACU was being utilized as an ICU, the PACU staff was rehomed to the Trauma Intensive Care Unit (TICU). The TICU staff operated out of the Cardiac Intensive Care Unit (CICU). And finally, the CICU was combined

with the Surgical Intensive Care Unit (SICU). The hospital was afforded the ability to do this due to reduced volumes across the house.

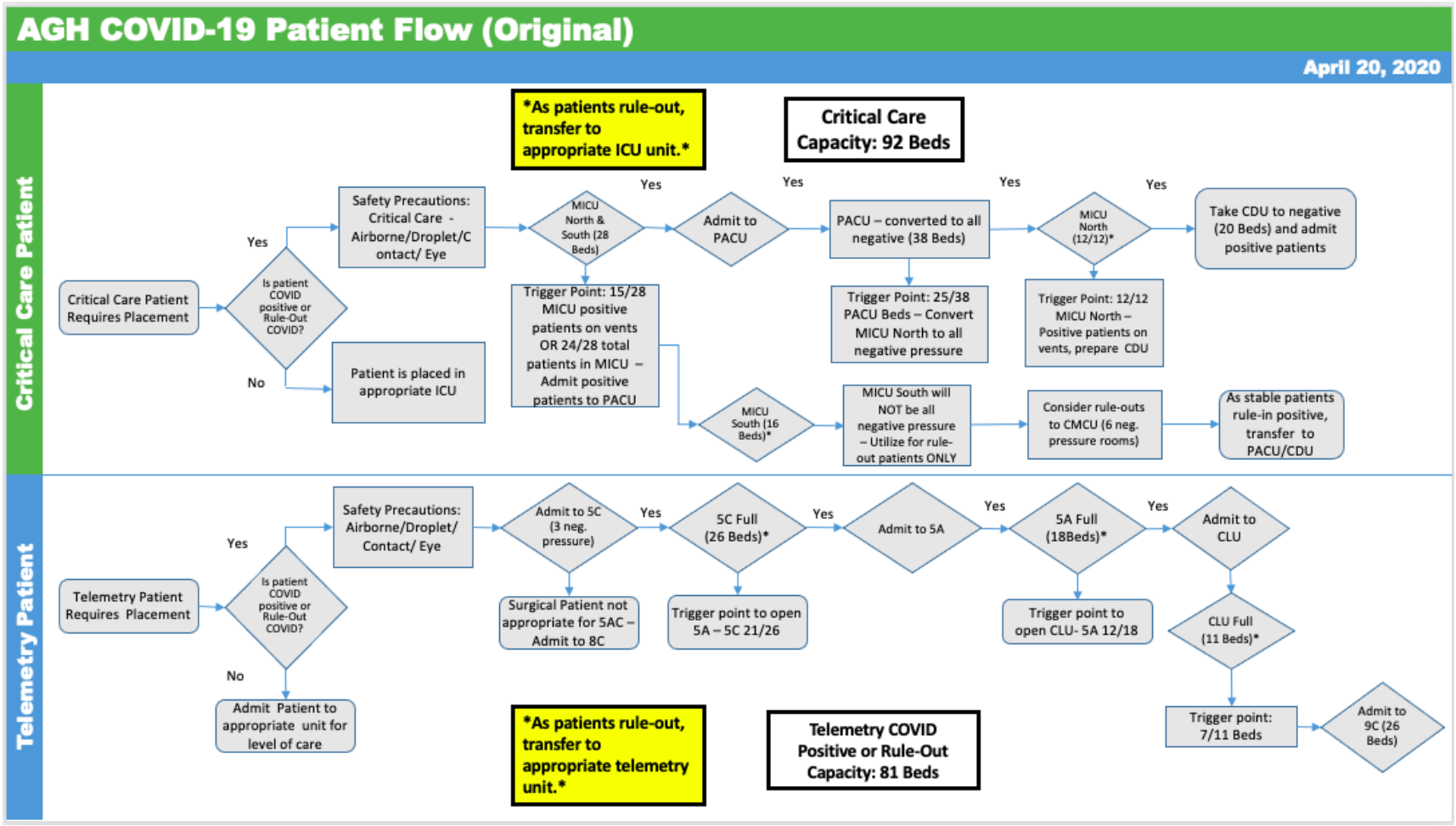


Figure 1: AGH Patient Flow Algorithm (DiCuccio et al., 2020)

6.0 STAFFING CONSIDERATIONS

Staffing in highly complex acute care facilities is among the most challenging tasks a healthcare organization can face. The pandemic only increased that challenge while staffing became the initial focus after COVID units were identified and installed. Volumes at AGH dropped to about 25% of pre-pandemic levels, which allowed for registered nurse (RN) staff to be available to assist in other areas of the hospital as needed. A staffing plan was identified and put into place for the units that were going to be treating acute COVID-19 patients.

As previously mentioned, the MICU was identified as the primary COVID-19 unit for severe illness. In addition to the MICU, telemetry unit, 5C (fifth floor of main hospital) was identified as an additional unit for less acute COVID-19 patients still needing medical attention. Hospital leadership determined that these respective units would use their own staff to meet their staffing needs. The focus on these units became education regarding the newly identified infectious disease as well as personal protective equipment, and the assurance that staff were aware of the severity of the virus and how to protect themselves from contracting it during patient care.

The next staffing challenge that nursing leadership would face was that of staffing the newly formed 38-bed PACU ICU. The CNO took the first step in staffing this unit and realized the importance of gathering interest from RN staff with critical care backgrounds. The CNO sent a message out to all nurses with critical care experience and received an overwhelming response. Due to the shifts in ICUs and the decreased volume throughout the hospital, 50 RNs volunteered their services to work in the PACU ICU. Additionally, a nurse manager, assistant nurse manager, and nursing supervisor were identified to lead the unit. This group toured the area, addressed the safest entry and exit points of the unit, and familiarized themselves with the equipment. They also

received the same education and PPE considerations as the staff on the other previously identified units. However, it was apparent that a more comprehensive staff was needed if the hospital were to see an intense surge of patients. Therefore, additional staffing plans which included physicians, APPs, respiratory therapists, RNs, and ancillary staff was created to address the extensive needs of the critically ill COVID-19 patients (**Figure 2**). The staffing plans addressed the needs as maximum patient counts were potentially eclipsed.

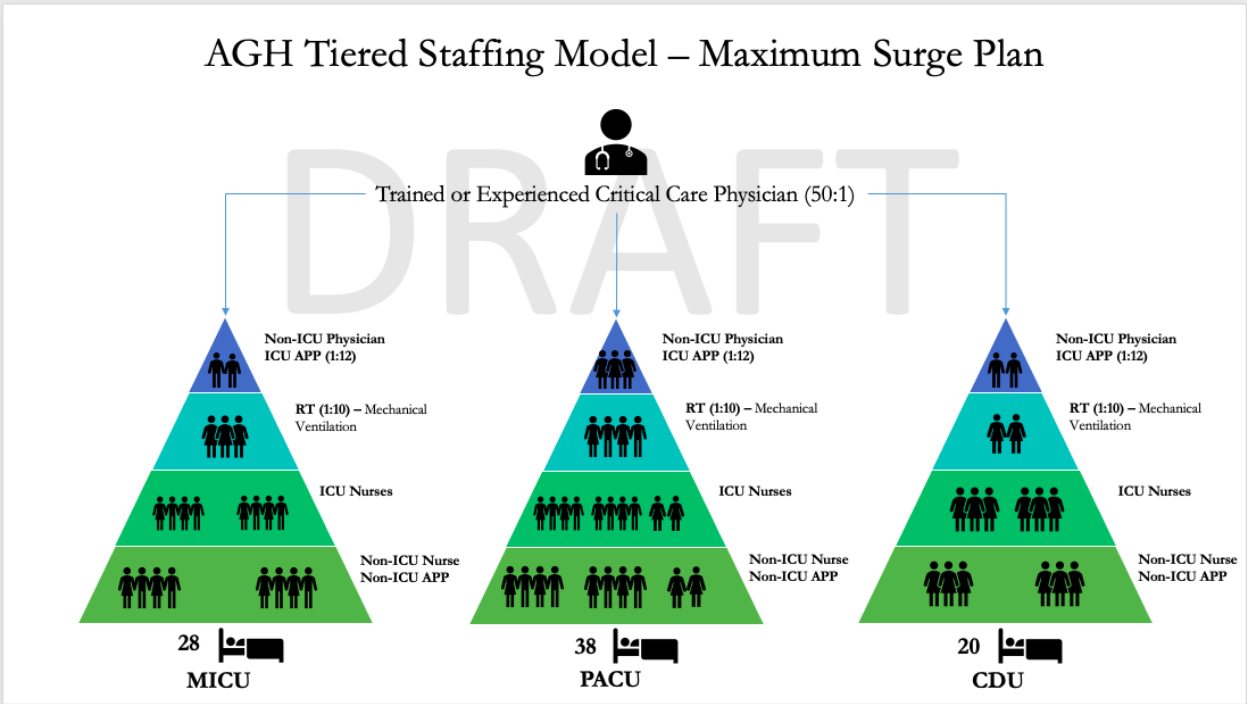


Figure 2: AGH Tiered Staffing Model (DiCuccio et al., 2020)

7.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Amid space planning and staffing considerations, securing adequate personal protective equipment was also an area of focus for hospital leadership. AGH conducted an initial assessment of all PPE inventory. At the outset of the pandemic, additional strategies to conserve PPE were used. Limiting exposure to a specific group of the care team and patient "cohorting", which is the idea of grouping patients in the same general vicinity, were a couple methods that were implemented by hospital leadership. The hospital's professional practice and education team quickly provided training and education regarding contact, droplet, and airborne precautions while treating COVID-19 patients. Addressing these precaution measures became a priority at the outset of the pandemic.

The MICU initially used powered air-purifying respirators (PAPRs) as their primary source of respiratory protection. However, leadership quickly realized that there were too few PAPRs available to sustain continued use throughout the units. AGH leadership shifted focus to N95 masks. These masks needed to be fitted to each individual that wears them. Fit testing became the next major focus and was led by the Magnet Program Director for the facility due to her shift in role amid the pandemic response. Fit testing for these masks were prioritized by potential interaction with COVID-19 patients. Therefore, in early April, MICU and Emergency Department staff were the first groups to be fit tested for N95s. This process of fit testing was phased out to the anesthesia department, respiratory therapy (RT), operating room staff, 5C staff, and followed by other ancillary staff in order of exposure risk. In early May, the facility concluded fit testing for N95 masks. Upon completion, all N95 fit testing was done on a "just-in-time" basis. Amid testing,

N95 masks went through reprocessing to disinfect a maximum of 3 times. Collection bins were placed outside of the high usage units to collect and be sent to central sterilization for cleaning.

Meanwhile, AGH was able to acquire N100 masks to supplement N95 usage. N100 masks quickly became the standard for protection for staff. Additional fit testing for these masks started in mid-April and was again prioritized by exposure risk. Between PAPRs, N95, and N100 masks, sufficient coverage of staff needing this PPE was realized. Additional supplies and equipment such as fanny packs, face shields, hand sanitizer, and loop masks were also acquired by the facility to supplement proper PPE usage (DiCuccio et al., 2020).

8.0 EMPLOYEE WELLNESS

Upon facility reconstruction being completed and staffing considerations being accounted for, AGHs frontline staff began to treat COVID-19 patients routinely. Next, an important consideration for nursing leadership pointed to ensuring the well-being of the employees. According to Vizheh et al., healthcare workers have faced aggravated psychological pressure and increased reports of mental illness in the face of COVID-19 (Vizheh et al., 2020). Hospital leadership took the necessary steps to combat the pressures brought about by the virus. A combination of multiple steps were enacted to combat the increased stress and anxiety in the workplace such as providing internal and external resources for staff to use as stress outlets, identifying spaces on campus for dedicated relaxation, and increasing transparency and communication in the face of the pandemic. This combination of tools and resources played an integral role in easing the stress and anxiety that came with being on the frontlines of treating COVID-19. It allowed for a sense of normalcy pertaining to fear and angst in the face of the pandemic. In addition, increased rounding by hospital and nursing leadership increased support for frontline staff.

9.0 ANCILLARY SERVICE LINE INVOLVEMENT

Certainly, the operational response couldn't solely be done without the support of other divisions within AGH. Information Technology (IT), Pharmacy, RT, Dietary Services, and Environmental Services played an integral role in the assurance that AGH was prepared for all scenarios.

9.1 INFORMATION TECHNOLOGY (IT)

The IT department played an integral role in the mobilization of new technologies in the newly and space planning efforts at AGH. From the outset of the pandemic, IT quickly got to work with assuring that all newly formed COVID-19 surge units acquired all the necessary monitoring equipment, pharmacy equipment that had an IT interface, print, cameras, and lab label printers. Within this equipment allocation process, video cameras were installed at the bedside in the PACU ICU to be used for patient monitoring so to limit contact between the medical staff and the infected patient. IT also worked with the volunteer pool of registered nurses to assure they had access to all of the new technology and equipment in the new unit they were assigned to work in. Simultaneously, the IT group made strides to build out the newly formed COVID-19 units within the hospital's electronic medical record. There were changes in room number, space allocation, and unit shifts from operational units to inpatient units (PACU ICU) included in this build out. Without IT's prominent role, it would've been incredibly difficult to track patients being treated in these newly formed units.

9.2 PHARMACY

Pharmacy played an important role in the medication distribution of the totally negative air pressure units in the MICU and the PACU ICU. Appropriate placement of automatic prescription dispenser was assessed when planning for unit reconstruction. The Director of Pharmacy for AGH acted as a valued part of the planning committee and made recommendations in tandem with nursing administration to place these dispensers external to the units. In addition, an automated dispensing machine was left inside these units with a small stock of relevant prescriptions for emergency situations and to reduce the risk of entering and exiting the unit unnecessarily. Nursing and pharmacy worked together to manage medication processes for the identified COVID units.

9.3 RESPIRATORY THERAPY (RT)

Due to the nature of the COVID-19 virus primarily impacting the respiratory system, the RT department played a central role to the hospital's response to COVID-19. The department immediately assess the number of ventilators in the facility. After initial assessment, the RT department was able to amass 75 ventilators with ability to procure more by way of equipment alterations to perform similar functions to that of a traditional ventilator. The director of RT participated in biweekly network phone calls to assess respiratory equipment usage and supplies so to be certain that the proper allocation of equipment was met at AGH. RT provided valuable input in daily meetings that allowed for staffing and appropriate equipment allocation to be assessed.

9.4 DIETARY SERVICES

An immediate need arose requiring dietary services to identify a process to deliver food to infectious units. The director of dietary services was involved in the surge planning calls to assist in developing the process along with the nursing staff. Entering and exiting identified units was a priority of the group in keeping the dietary staff safe. In fact, dietary staff did not enter identified COVID-19 units and were directed to deliver food and enteral nutrition to nursing who would enter the unit to reduce risk and conserve PPE. Appropriate signage was developed to identify COVID patient rooms so that dietary staff wouldn't mistakenly enter an infectious room.

9.5 ENVIRONMENTAL SERVICES (EVS)

EVS played a major role in the preparation of the newly formed COVID-19 PACU ICU unit in addition to the increased cleaning workload across the hospital. As the PACU ICU was constructed, EVS thoroughly cleaned the area before and after the negative air pressure installations were made. Also, the PACU ICU was cleaned daily by EVS staff.

10.0 RESULTS

As a result of surge planning at AGH, the hospital was adequately prepared to meet the increased bed capacity demands presented by the COVID-19 pandemic. The hospital was able to amass 92 critical care (ICU) beds for critically ill COVID-19 patients and an additional 81 beds for less acute cases of COVID-19. A total of 173 ICU and medical surgical beds were identified as possible placement beds for hospitalized COVID-19 patients. While the hospital was never overly strained, there were concerns in late 2020 and early 2021 that if the trend of critically ill COVID-19 patients continued upward that ICU beds may become problematic. However, shortly thereafter, acutely ill COVID-19 patients began to trend downward.

As a whole, the height of patients hospitalized at AGH with the primary diagnosis of COVID-19 was 93. This occurred in mid-December 2020. With a total capacity of 173 beds dedicated to COVID-19 patients, AGH was able to avoid the need to utilize its entire allotted capacity of beds denoted for these patients. It's also important to note that these patients were distributed between ICU and other less acute floors throughout the hospital. At peak COVID-19 volume at AGH, 47 patients were located on medical surgical floors, but not deemed to be in an ICU critical care setting. Simultaneously, 26 patients were located in an ICU, but not in critical care, while 20 patients were located in an ICU in critical care (**Figure 3**).

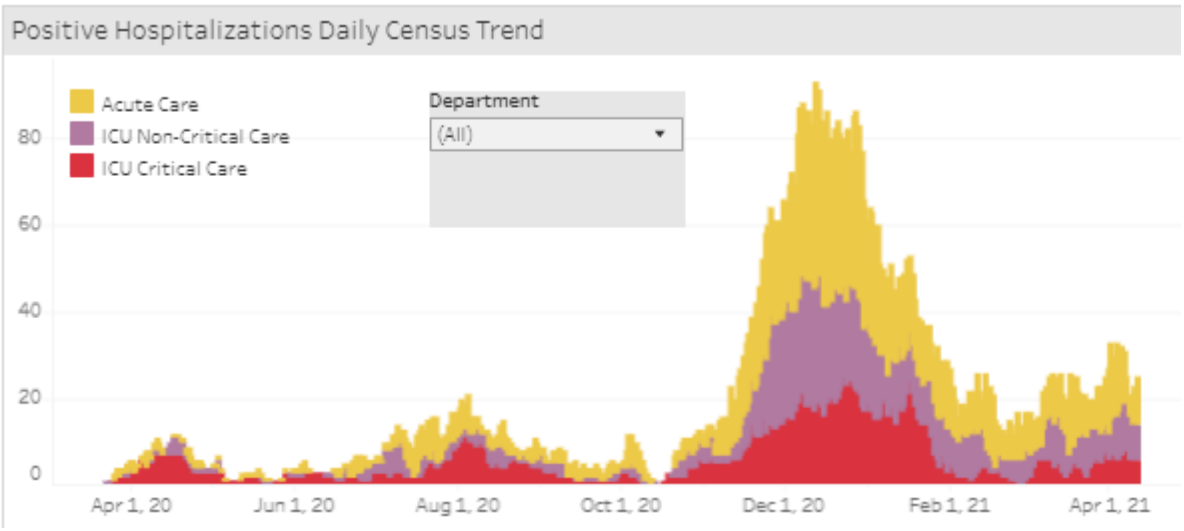


Figure 3: Hospitalizations Trend at AGH

As previously mentioned, the MICU and PACU ICU were the primary placement areas for critically ill COVID-19 patients. The peak volume realized in the MICU at any given point was 19 total COVID positive patients (**Figure 4**). Due to the strain and overwhelming nature of the virus on staff, the decision was made to open the PACU ICU during the peak of the virus from late November to late January. This allowed the hospital to decompress operations in the MICU. Shortly thereafter, the highest number of patients the PACU ICU contained at any given point was 8 (**Figure 5**). While both of these areas were within their maximum capacity limits as outlined by the surge planning team, COVID-19 patients were located throughout the hospital in a variety of care environments, as well. One major success at AGH was that the CDU wasn't needed for ICU beds to contain COVID-19 patients.

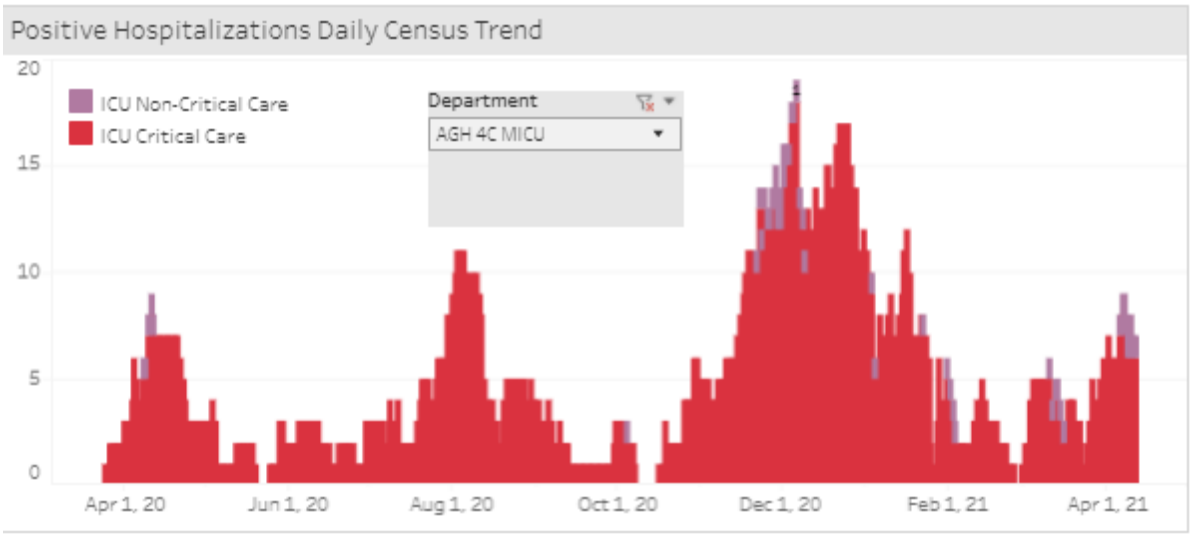


Figure 4: Hospitalizations Trend in MICU

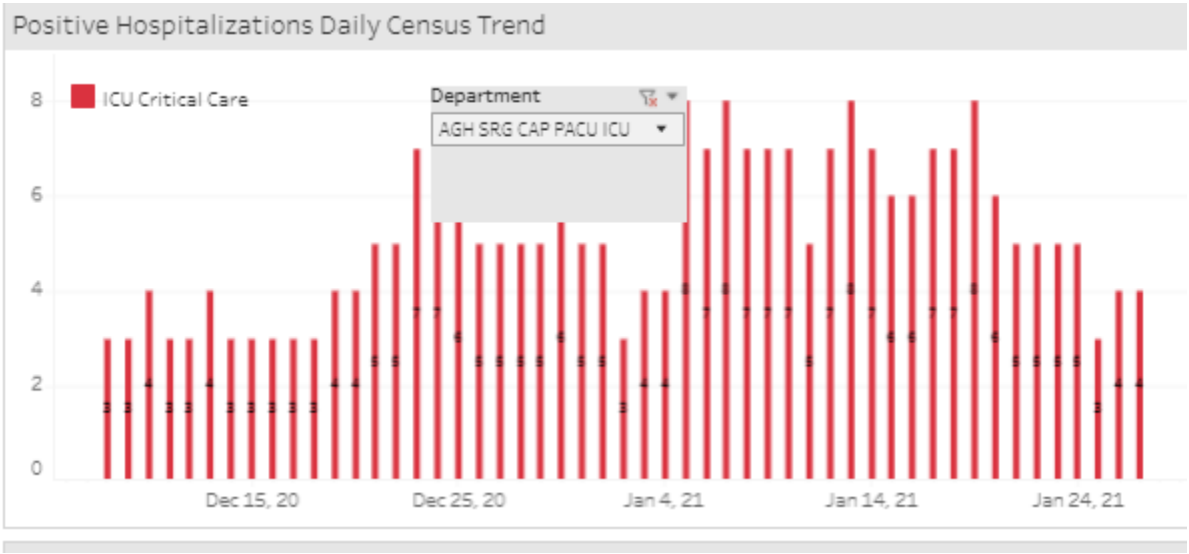


Figure 5: Hospitalizations Trend in PACU ICU

11.0 DISCUSSION

The response to COVID-19 at AGH could look completely different than operational responses at other hospitals. However, the principles apply to all healthcare facilities. Some points of emphasis and lessons learned from AGH's response include that of bed planning, negative air pressure rooms, and PPE supplies. While AGH was able to maintain an adequate number of beds throughout the peak of the COVID-19 pandemic thus far, it certainly made hospital operations difficult and was an extreme challenge to the frontline staff. If AGH were to identify 20% of its beds as "immediately available", as recommended by emergency planning experts, that would account for roughly 115 beds of the total capacity at the hospital. In hindsight, the hospital planned for about 30% of immediate bed availability in identifying 173 beds. AGH planned for the "worst case" scenario and amassed more than an adequate number of beds to meet the demand of critically ill COVID-19 patients. While the hospital could've left beds off the plan as a "best case" scenario, it was the objective of the hospital to be prepared for extremely high volumes of COVID positive patients as seen in places like China and New York City. In the future, the hospital would likely plan for a "worst case" scenario again, even though the total number of beds wasn't in question throughout the pandemic.

While in a state of a pandemic emergency, a hospital can't be "overprepared" to accommodate increased patient demand. That being said, there are some impacts to identifying more than enough patient beds throughout a hospital. As mentioned, the PACU ICU was identified and utilized as the second ICU space for critically ill COVID-19 patients. The decision was made to use this space due to the cancellation of elective surgeries, which freed up bed availability in this unit. While the unit was effective in treating and managing COVID-19 patients, it's also a

tremendous asset to the hospital's surgical process. In the beginning of the pandemic, identifying and using this space wasn't an issue, but when surgical volumes returned to pre-pandemic standards and COVID-19 volumes began to surge in late November 2020, it was strategically difficult to manage both patient services simultaneously. While the standard "PACU" was rehomed to a different unit, staff familiarity with the original space is helpful in providing quick and effective care. The PACU ICU was only functional for a few months, but in the future, the hospital might plan to use a different unit to accommodate surge capacity so to not disrupt surgical processes.

As previously mentioned, it was apparent that there was a lack of negative air pressure rooms throughout the hospital. The facilities team was forced to enact many facility changes to accommodate the precautions needed to make entire units and certain rooms negative air pressure. Something to consider for the facility is to build in more negative air pressure compatible rooms. In the case of a future pandemic, maintaining a larger number of negative air pressure rooms in the facility can only be beneficial in the initial bed planning stages of a pandemic response.

Lastly, AGH was lucky enough to never face extreme problems with PPE supply. Nonetheless, before the COVID-19 pandemic AGH never relied heavily on N95 and N100 masks as safety precautions for staff. PAPRs were used for higher level safety precautions and, otherwise, surgical masks and other PPE were used to accommodate other patient interactions. As the CDC provided guidance on the need for fit tested masking, it became apparent that all high-risk, patient-facing and some non-patient-facing staff would need to quickly be fit tested. In the future, staff could be routinely fit tested to be prepared to treat any highly infectious diseases, especially those that result in an emergency response.

12.0 CONCLUSION

AGH was forced to adapt to the rapidly changing conditions resulting from the COVID-19 pandemic in March 2020. Many considerations were made to accommodate the highly infectious nature of the virus, which included space reconfigurations, personal protective equipment assessment and distribution, staffing considerations, and more. The facility was able to adequately and appropriately respond to the intricacies that were brought forth by the pandemic. Thorough bed planning, particularly, was an emphasis for the hospital and adequate capacity was identified for the increased surge of COVID-19 patients. However, this is one facility's response to a pandemic. While the general principles apply to hospital facilities at-large, specifications are needed to address each hospital separately. AGH leadership and staff were able to take this response as a learning experience in order to address future concerns regarding pandemic responses.

APPENDIX A PROJECT PLANNER – COVID-19 RESPONSE

Start Date	Workstreams	Responsible Person(s)	Action Steps to Achieve the Goal	Actual Completion Date

3/31/20	Facilities: Negative Pressure Conversions (MICU/PACU/CDU)	Director of Facilities	• MICU North to negative pressure
			  • Follow-up about ICRA barrier – MICU
			  • Place new windows in MICU North (4/6/20) AND MICU South if needed
			  • Placing small air machines/window panels in MICU North when converting to negative pressure
			  • Shower space on 5 (Manager of MICU/5C)
			  • 5B locker room/handicap rooms on 5A & 5C
			• Secondary/Primary PACU to negative pressure
			  • Seal off pressure where needed – OR doors to be sealed
			  • PACU walkthrough – Manager PACU/Holding, Manager SPU/Sec PACU, Director of Surgical Services, Director of Facilities
			  • Moving fans outside of PACU (4/17/20)
			• Repeated 4 hour negative pressure checks (MICU/PACU)
				4/17/20

			• Received 10 more machines, 4 more have been ordered – should have appropriate number • Equip negative pressure areas with necessary air machines • CDU to negative pressure	
4/1/20	Combing/Moving ICUs	Manager CICU Manager SICU/12A Director of Nursing	• Combine CICU/SICU (4/6/20) • Contact Cardiologists for approval (4/4/20) • 11A to 12A (4/6/20) • TICU to CICU (4/7/20) • PACU to TICU (4/10/20) • PACU for ICU (4/10/20)	4/11/20
3/31/20	Environmental: Primary/Secondary PACU to an ICU	Manager PACU/Holding Manager SPU/Sec PACU Manager MICU Assistant Nurse Manager MICU Director of Facilities Director of Surgical Services	• Prepare the primary and secondary PACU to become an ICU (negative pressure accommodations) • Please report any equipment needed and facility concerns you may have • Assess inventory of monitors, scanners, etc. and stock what is needed at bedside • Remove unnecessary equipment • Cross-hallway traffic between COVID and OR patients • Contacting Director and Manager of Materials Management to stage carts for ICU supplies • Determine best usage of carts	4/16/20

			• Swap Trauma for PACU carts
			• Possible trauma involvement to assess safety precautions
			• Provide definitive entrance/exit flow
			  • Director of Facilities: assess feasibility and work out details with Director of Surgical Services (Resolved)
			  • Finalize with core team input
			• Receive maps from engineer to determine square footage (Contacted 4/3/20 & 4/6/20)
			• Equipment education – cardiac monitoring system
			• Final ICRA installation completed Saturday (4/11/20)
			  • Manager and ANM of SICU to approve ICRA barrier
			  • Assess inclusion of nurses station inside ICRA barrier
			  • Ability to place opaque panel to allow for better communication (Panel placed – 4/14/20)	

4/8/20	Operations: PACU/ICU	Manager of SICU/12A
		
		Assistant Nurse Manager SICU
		
		Director of Nursing
			• Development of staffing core team
			• Beds
			  • Bed assessment
			  • Beds available (23 beds as of 4/9/20) – Manager of SICU, Director of Facilities
			  • Need 15 additional ICU beds to fulfill PACU/ICU capacity
			  • Consider 11A for additional beds
			• Phones transferred from trauma to PACU
			• Isolation room vs. soiled utility for doffing – Doffing room
			• Scheduling – assessing multiple models (2 week schedule completed)
			  • 2 hour staff rotations due to negative pressure environment
			• Proning Team
			  • Physical Therapy (Contacted 4/17/20) – 6 available to join proning team, 2 per day
				Ongoing

			• General education
			  • PPE, monitors, donning & doffing, environment, etc.
			• UV Sterilization System – not safe for cleaning in PACU
			• Pharmacy
			  • Code Bags
			  • RSI Kits
			  • Medication Dispensing Machine
			  • Fluids
			• Calling codes – Operator/Phone office
			  • Whiteboards
			  • Code called by secretary outside negative pressure unit
			• Showers space
			  • 2 male, 2 female showers (Gym in APB)
			  • Badge access to APB
			  • List of names- Manager of SICU
			• PPE – One Piece Clothing Covers vs. Hospital Scrubs – Network standard
			  • Cooling vests (16), 24 inserts
			  • Push to talk microphones & radios (12)
			  • Cleaning process for mics and vests – use purple top wipes
			• Securing the unit
			• Process for COVID patient belongings
			• Charge nurse cell phones – 3 from 10th floor
			• CRRT Process – Priming outside space
			• Ear Protection (available in donning area)
			• Equipment/Supplies needed
			  • Thermometers
			  • Nurse servers
			  • WOWs – (sufficient number, others available)
			  • Defibrillators
			  • Code Carts
			  • Glidascope (4/17/20)
			  • Pressure/Temperature Cables
			  • Ultrasound Machine
			  • Warning signage	

			• Label Printers/Scanners • Ramp up to normal operations – Secondary PACU holding back to OR (4/23/20) • Maintain Primary PACU – reopen over a weekend (2 weeks – dependent on surge and ICU beds) • Signage to notify negative pressure in primary PACU after secondary PACU is converted back to original use • Move supplies from secondary to primary • Deconstruction of anti-room- Director of Facilities, Manager of SICU	
4/9/20	Environmental: CDU	Director of Facilities	• Assess feasibility of CDU to negative pressure • Full CDU conversion • Additional air machines required • Work with patient safety regarding safety precautions • Negative pressure machines installed • Similar processes applied to CDU that were used in PACU/MICU, if needed	4/17/20
4/2/20	Donning & Doffing Spaces (MICU/PACU)	Manager of MICU Manager of SICU Director of Facilities	• Donning and doffing spaces identified (PACU and MICU) • Identified entrances and exits • Donning in locker rooms, doffing in secured space (MICU) • Arrest carts for donning supplies (20 carts available) • See updated PACU diagram (4/7/20) - (Figure 1, attached) • See updated MICU diagram (4/6/20) - (Figure 2 attached)	4/16/20
4/2/20	Patient Flow Algorithm/Triggers	Director of Nursing	• Develop patient flow algorithm of patients (4/3/20) • Critical Care • Use proper eye, droplet, airborne, contact precautions	Ongoing

		Director of Nursing Manager of MICU Assistant Nurse Manager MICU Administrative Resident	• If COVID+ or COVID rule-out, admit to MICU North, MICU South for rule-outs ONLY (28 total beds) • Trigger Point: 15/28 MICU positive patients OR 24/28 total patients → Admit to PACU (38 total beds) • Trigger Point: 25/38 positive patients → enact total negative pressure in MICU North and fill 12/12 beds • Once full, prepare and open negative pressure CDU (20 beds) • Telemetry • Use proper eye, droplet, airborne, contact precautions • Admit to 5C (26 total beds) – However, surgical patients not appropriate for 5AC admitted to 8C • Trigger Point: 21/26 beds → Admit to 5A (18 total beds) • Trigger Point: 12/18 beds → Admit to CLU (11 total beds) • Trigger Point: 7/11 beds → Admit to 9C (26 total beds) • Upon the use of CLU beds, CLU patients pre- and post- recovery, will go to SPU and PACU (Approx. 4-6 patients) • COVID+ and COVID R/O identified by gold ID wristband and gold door magnet – flyer issued to units • Removed upon negative result • Don't block hinges with magnet • Don't jam aluminum doors • Transporting and discharging patients • Terminal extubation procedure developed	
3/31/20	Staffing	Director of Nursing Director of Nursing Manager of SICU	• Contact labor relations regarding staff usage • Send communication from CNO for COVID unit volunteers • Obtain FTE numbers from CICU/SICU/PDP/PACU/SPU (4/3/20) • Volunteers from ICUs/PACU/PDP	4/16/20

		Assistant Nurse Manager SICU	• Volunteer Communication (4/6/20) • Volunteers from Ancillary Depts. CLU, EP, Coordinators, IR, OR, Navigators • Maintain a list with ICU experience – include employee ID/manager ID/experience/login/EHR access • Part-time volunteers can be asked to move to full-time • CRNAs – Met with Chief CRNA • 12 hour shifts (cut staff in half), no more than 24 areas run per day, increased coverage at night, skills: airways, vents, lines, drips • Co-assignments with ICU nurses • Can CRNA students be used as ICU nurses? Escalated to network level • CRNAs will be involved with physician plan, RTs will take on vent responsibilities in nursing plan • Development of AGH Tiered Staffing Model – Maximum Surge Plan	
4/16/20	Respiratory Therapy	Manager Respiratory Therapy	• Daily ventilator update (50 total) • PACU • RT Cell Phone for PACU • 3 ventilators on standby • Disposable bronchoscopy cart • Racemic epinephrine • Double flow meters • RTs fit-tested for N100s • Liquid seal for facial breakdown • Behind the ear protection – headbands	Ongoing

4/6/20	Employee Wellness	Director of Nursing
		
		Supervisor of Psychiatry
			• Moral Injury Information – adoption of military practices
			• Magellan – employee assistance
			• Call in line 24/7
			• Resource sheet for units (Created 4/7/20) – Ready for distribution (4/8/20)
			• Decompression room
			  • Located in café dining rooms 1-3
			  • Anxiety workbooks available
			• Hope Huddles – daily huddles on units with inspiring information
			• Meet Aunt Bertha – interactive emotional support site to address stressful situations
				4/16/20

3/31/20	Communication Plan	Director of Nursing Director of Nursing	• Assess how we will be communicating to our ICUs (MICU/PACU) • Use leaders to feed information to frontline staff • Create question and answer sheet for units to use as guidance	4/16/20

3/31/20	PPE	Director of Magnet Program	• PPE education to assure all staff is wearing equipment correctly – in all areas
			• Just-in-time education for PAPRs
			• N95 fit testing for staff
			  • Prioritization by units
			  • MICU/ED completed (4/2/20)
			  • Reprocessing procedure developed for N95s (4/3/20)
			  • Collection bins
			  • Up to 3 times
			  • Tape identification on bands
			  • No makeup/lipstick worn with N95 masks
			  • Can fit about 6 staff per 30 min.
				Ongoing

			• Advanced fit testing
			• N100 Masks (376 as of 4/9/20) – fit testing to begin Monday (4/13/20) (MICU)
			  • 890 N100s as of 4/13/20
			  • Additional N100 pickup (4/16/20) – All mediums, requesting smalls – Continue to reprocess smalls
			  • Awaiting more small N100s (4/24/20)
			  • Reprocessing
			  • Collection bins
			  • Soak for 10 min, dry for 2 hours
			  • Page 4118 to have masks delivered
			  • First tier distribution – RT, anesthesia, all MICU, all PACU, ED, critical care
			  • Second tier distribution - PDP staff, 5C, CMCU. 8C, 9C
			  • Staff w/ personal device – RT, anesthesia, ICU staff, MICU medical staff, PACU staff, RIC nurses
			  • Storage of PPE – hang in locker in a breathable bag
			  • Clean with purple top wipe – allow to dry
			  • 634 employees fit tested for N100s (4/24/20)
			• Saccharin solution shortage – Resolved by pharmacy (4/22/20)
			• Face shields – Distributed week of 4/20/20
			• 15,000 fanny packs – Arriving to CNO (4/17/20)
			  • Distributed week of 4/20/20
			• Clinical Engineering/Facilities/Security to be fit tested
			• MICU transitioning from PAPRs to N100s
			• PAPRs reallocated to PACU, MICU for one off access
			• Mask always policy– 4/20/20	

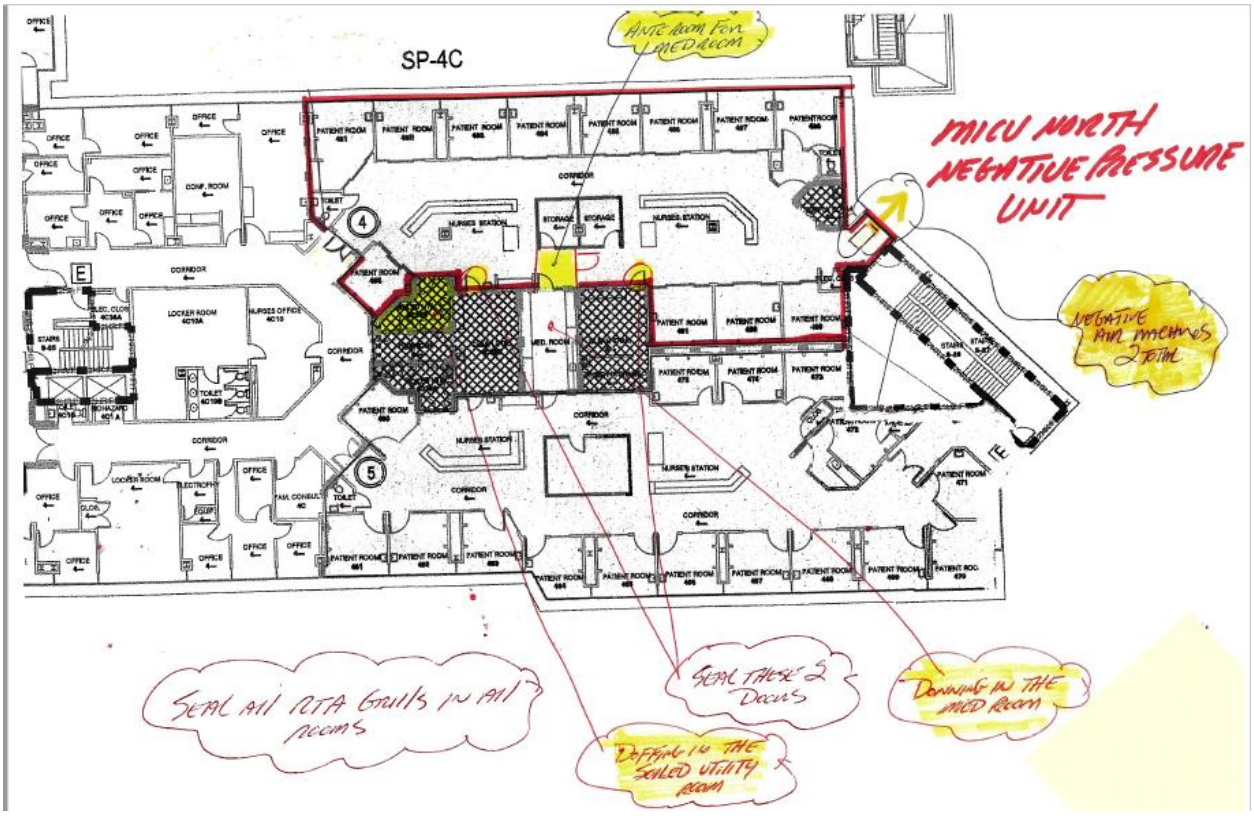
4/2/20	IT/EHR	Director of Nursing
		
		Director of Nursing
		
		IT Relationship Manager
		
		Director of Regulatory Affairs
			• Assure that we are making secondary PACU beds are live on inpatient board
			• EHR and Medication Dispensing System access for RN volunteers
			• Documentation
			• Walk through Trauma & PACU (Manager SPU/Sec PACU/Manager PACU/Holding/Manager MICU)
			  • Dependent on move – possibly 4/8/20
			• Relevant cost center information
			• PACU area build in EHR
			  • 6 additional beds accurate (4/13/20)
			  • Phones to PACU
			  • Rover Phones – Video capability? Not available.
			• Build for sprint 1 for AGH moved to PRD (production)
			  ○ Confirmed EHR build for AGH PACU to Trauma ICU must be completed and migrated by 4/10.
			• Follow up with Manager PACU/Holding to understand questions, concerns, and workflow
			  ○ Combinations/moves of CICU to SICU and TICU to CICU: add accommodation codes (the same accommodation codes that were used previously)
			  ○ EHR build teams need 3 full days to build and test for up to 5 total departments
			  ○ For some AGH Units, new departments do not need created, just adding new rooms and beds
			• Additional surge beds created
			• 10C department (4/10/20)
			  • 41 capacity + 7 Surge beds = 48 TOTAL (Including 1 AIIR)
				Ongoing

			• + Treatment room equipped with gasses = 49
			• 5C department (4/10/20)
			  • 26 capacity + 23 Surge beds = 49 TOTAL (Including 1 AIIR)
			• 6C – CMCU (4/15/20)
			  • (9 ICU capable of 30) 30 capacity + 11surge beds = 41 TOTAL (Including 1 AIIR)
			• 6A – CMCU (4/15/20)
			  • (7 ICU capable of 30) 30 capacity + 10 surge beds = 40 TOTAL (Including 6 AIIR)
			• 5A (Including CLU) (4/15/20)
			  • New inpatient department (currently outpatient)
			  • 38 capacity + 12 Surge beds = 50 TOTAL (1 AIIR)
			• Units w/ Integrated Devices
			• Surge Units available in EHR (4/16/20)
			• Video Monitoring System (4/20/20)
			  • Ceiling Mount (On hold) – Follow up with legal department
			  • Cart for consults at each bedside (Demo 4/16/20)
			  • Looking for smaller carts
			  • Patient privacy/nurse privacy
			  • Ability for nurse to turn off monitoring – Can ONLY turn off from outside, but can cover camera
			• Disaster Navigator for Surge Patients in EHR	

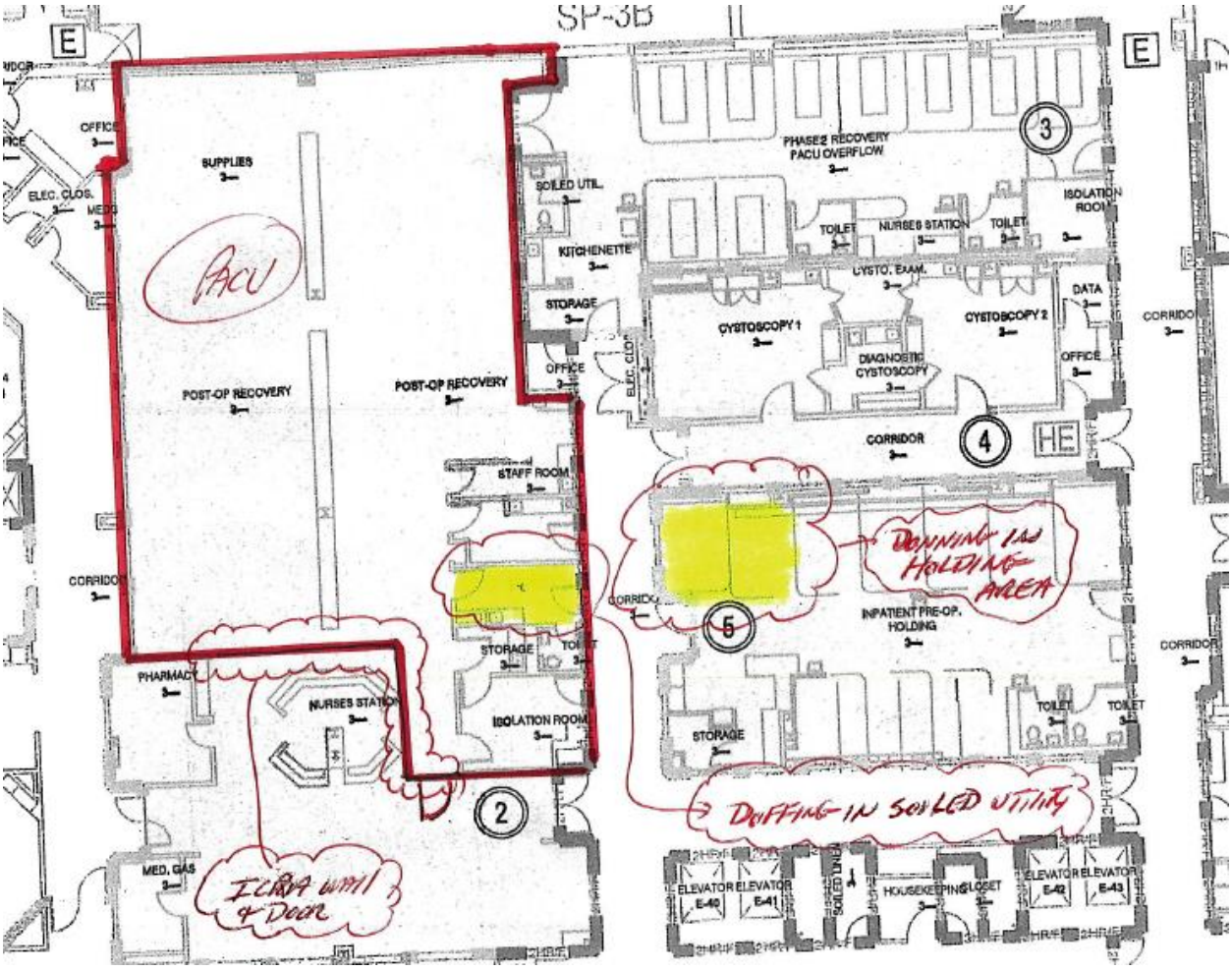
4/1/20	Pharmacy (MICU)	Director of Pharmacy Manager of MICU Director of Facilities	• Determine process of distributing medication in COVID+ areas/Medication Dispensing System filling (4/3/20)	4/3/20

4/1/20	Pharmacy (PACU)	Director of Pharmacy Manager of SICU Director of Facilities	• Determine process of distributing medication in COVID+ areas/Medication Dispensing System filling • Assess OR satellite pharmacy closure • Seal off pharmacy from PACU • Fit testing for pharmacy employees • Seal off tube system to prevent contamination – No tube transmission to and from the unit • If trauma used, OR pharmacy will be trauma pharmacy • Walkthrough of PACU on 4/6/20	4/8/20
4/1/20	Food Services	Director of Food/Nutrition Services Manager of Nutrition	• Prepare for potential surge and need for staff to build trays • Assess carts entering areas/logistics of delivering food • Interface food services software with PACU in EHR (4/7/20) • Host/Hostess awareness of COVID+ and COVID R/O patients – Proper signage necessary • 5c/CMCU drop tray deliveries – Manager of MICU/5C, Director of Food and Nutrition Services • Created and stocked PACU nutrition station	4/13/20
4/9/20	Environmental Services	Director of Environmental Services	• Cleaning in PACU before and after ICRA • Daily cleaning in PACU • Shower updates for cleaning (Gym in APB) • Cleaning reflected on bed board – resolved • Assure the EVS manager adds the new unit to EVS employees allowed sectors in their housekeeper record so staff can cover the beds in the unit	4/17/20

APPENDIX B MICU LAYOUT



APPENDIX C PACU ICU LAYOUT



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